APPLICATIONS OF HYPERSPECTRAL REMOTE SENSING IN AFRICA

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1. INTRODUCTION

Africa is a continent of mineral wealth with many known mineral deposits and large undiscovered potential. There are many suitable applications of hyperspectral remote sensing in this environment. In Anglo American there has been a drive to use hyperspectral scanner technologies to assist in the fields of geological exploration, environmental monitoring and land use applications. In this presentation a few of the examples will be shown to demonstrate the applications and use of hyperspectral data in the mining industry.

2. BACKGROUND

One of the fast growing and expanding areas of remote sensing is hyperspectral imaging, including the way in which the data is processed to effectively extract valuable information. In the years preceding the use of commercially available hyperspectral technologies, spaceborne satellites such as Landsat TM were used to generate alteration and maps for large exploration target areas based on broad mineral based definitions. While the spectral discrimination was good, the identification of minerals mapped was restricted by the limited number of spectral bands collecting the necessary information. However, with the development of hyperspectral airborne systems (e.g. HyMap), with an increased number of spectral bands, there is a greater potential for mineral discrimination and identification.

3. DATA HANDLING

Hyperspectral infrared techniques are one of the most suitable methods to obtain rapid and large amounts of mineralogical information. The processing of the spectral data requires system and data corrections to be applied prior to information extraction and data manipulation. The type of corrections that are applied is dependent on the scanner system used. In many instances, pre-processing and spectral processing algorithms have been developed internally within Anglo remote sensing technical unit to supplement standard processing routines being applied.

4. APPLICATIONS

The main applications of hyperspectral data in the mining industry includes mineral mapping, target alteration, generation of litho-spectral maps, and land use mapping and monitoring.

Hyperspectral data is often used not only to target alteration but to better map and understand the geological environment being explored. The identification of minerals is dependent on the spectral wavelength range of the spectrometer, the presence and strength of the absorption feature related to a specific mineral, and the existence of diagnostic features for accurate identification. However, not all minerals have diagnostic responses across the spectral ranges typically measured by infrared instruments. The direct detection of alteration minerals is often restricted to their spectral contrast. However, the mapping of alteration minerals with a low spectral contrast can be improved through the identification of unique mineral assemblages that are associated with the known alteration minerals itself.

Hyperspectral data have been often used in isolation to map alteration zones in order to target areas of possible mineralization. The value add of the spectral data can be maximized through the integration of associated spatial data sets, such as GIS-based maps during processing. These data sets can be used in the generation of textural and morphological maps that can assist in processing of spectral data. Morphological information can be generated either from integration of different data types such as hyperspectral, geological and regolith maps or integration of the different data sets provided by a single sensor. The spatial relationship between the identified spectral facies and parent lithology can assist in mapping of unique litho-spectral units to direct data exploitation efforts. This integrated approach in spectral processing of hyperspectral data has being successfully used in updating of the existing geological maps to aid target alteration mapping.

4. CONCLUSIONS

There is a growing demand for fast and effective spectral processing to extract meaningful information to generate mineral maps that can assist mining industry across its many operations. Hyperspectral data have been widely used in Africa to assist existing mining operations, for example in land use monitoring and environmental mapping. It has also been used in various green and brown field exploration programmes, through which extensions to the existing resources and/or new prospects are being investigated.

With the many applications and benefits of the hyperspectral data it is foreseen that its use will increase throughout the mining lifecycle in years to come.